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$$p=\frac{|\underline{b_1+b_2+b_3}\ \ |\underline{a_1+b_1}\ \ |\underline{a_2+b_2}\ \ |\underline{a_3+b_3}\ \ |\underline{a_1+a_2+a_3+2}}{|\underline{b_1}\ \ |\underline{b_2}\ \ |\underline{b_3}\ \ |\underline{a_1}\ \ |\underline{a_2}\ \ |\underline{a_3}\ \ |\underline{a_1+a_2+a_3+b_1+b_2+b_3+2}}$$

Let $\dfrac{|\underline{a_1+a_2+a_3+2}}{|\underline{a_1+a_2+a_3+b_1+b_2+b_3+2}}=A$, then the chance that all are of the first color is $p_1=\dfrac{|\underline{a_1+b_1+b_2+b_3}}{|\underline{a_1}}A$. $p_2=\dfrac{|\underline{a_2+b_1+b_2+b_3}}{|\underline{a_2}}A$ that all are of the second color. $p_3=\dfrac{|\underline{a_3+b_1+b_2+b_3}}{|\underline{a_3}}A$. that all are of the third color.

$p_4=\dfrac{|\underline{b_1+b_2+b_3}\ \ |\underline{a_1+b_1+b_2}\ \ |\underline{a_3+b_3}}{|\underline{b_1+b_2}\ \ |\underline{b_3}\ \ |\underline{a_1}\ \ |\underline{a_3}}A$, that b_1+b_2 are of the first color and b_3 of the third.

$p_5=\dfrac{|\underline{b_1+b_2+b_3}\ \ |\underline{a_1+b_3}\ \ |\underline{a_3+b_1+b_2}}{|\underline{b_1+b_2}\ \ |\underline{b_3}\ \ |\underline{a_1}\ \ |\underline{a_3}}A$, that b_3 are of the first color and b_1+b_2 of the third and so on for any combination.

When $a_1=5$, $a_2=3$, $a_3=2$, $b_1=b_2=b_3=1$.

Then $p=\dfrac{72}{455}$, $p_1=\dfrac{8}{65}$, $p_2=\dfrac{4}{91}$, $p_3=\dfrac{2}{91}$, $p_4=\dfrac{9}{65}$, $p_5=\dfrac{36}{455}$. The chance that there are none of the second color is $p_6=p_1+p_3+p_4+p_5=\dfrac{33}{91}$.

These numerical results are the same as those obtained by an algebraic solution of the same problem given by the late Professor Wolstenholme.

* * *

NON-EUCLIDEAN GEOMETRY: HISTORICAL AND EXPOSITORY.

By GEORGE BRUCE HALSTED. A. M., (Princeton); Ph. D., (Johns Hopkins); Member of the London Mathematical Society; and Professor of Mathematics in the University of Texas, Austin, Texas.

[Continued from the March Number.]

PROPOSITION XVI. *By any quadrilateral ABCD, of which the four angles together are equal to, or greater, or less than four right angles, is established respectively the hypothesis of right angle, or obtuse angle, or acute angle.*

Proof. Join AC. The three angles of the triangle ABC (fig. 14.) will not be together equal to, or greater, or less than two right angles, without the three angles of the triangle ADC being themselves also together respectively equal to, or greater, or less than two right angles, lest obviously (by the preceding) from one of those triangles be established one hypothesis, and another from the other, against the fifth, sixth, and seventh propositions of this work.

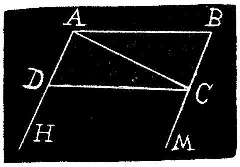

Fig. 14.

This holding good: If the four angles together of the premised quadrilateral are equal to four right angles, it follows that the three angles together of either of the just mentioned triangles will be equal to two right angles, and therefore (from the preceding) the hypothesis of right angle will be established.

But if indeed the four angles of this quadrilateral be together greater, or less than four right angles, similarly the three angles together of those triangles should be respectively either at the same time greater, or at the same time less than two right angles. Wherefore from these triangles would be established respectively (from the preceding) either the hypothesis of obtuse angle, or the hypothesis of acute angle.

Therefore by any quadrilateral, of which the four angles together are equal to, or greater, or less than four right angles, is established respectively the hypothesis of right angle, or obtuse angle, or acute angle. Quod erat demonstrandum.

Corollary. Hence: any two opposite sides of the premised quadrilateral being produced toward the same parts, as suppose AD to H, and BC to M; the two external angles HDC, MCD will be (Eu. I. 13.) either equal to, or less, or greater than the two internal and opposite angles together at the points A, and B, according as is true the hypothesis of right angle, or obtuse angle, or acute angle.

[To be continued.]

SOME SUGGESTIONS ABOUT VARIATION.

By ERIC DOOLITTLE, Professor of Mathematics, State University of Iowa, Iowa City, Iowa.

I think that in all of our Algebras the fundamental definitions of variation being in the idea of the ratio of two values of two changing quantities; the questions are first stated in the form of Proportions, and finally reduced to simple equations for solution.

It seems to me that this method is more cumbersome than necessary, especially in regard to the fundamental definitions, which thus involve such complex ideas that the student has a good deal of difficulty to grasp and apply